

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 050508-2300	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US04/05645	International filing date (<i>day/month/year</i>) 25 February 2004 (25.02.2004)	(Earliest) Priority Date (<i>day/month/year</i>) 25 February 2003 (25.02.2003)
Applicant EMORY UNIVERSITY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of ____ sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the Report

a. With regard to the **language**, the international search was carried out on the basis of:



the international application in the language in which it was filed.



a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☒ **Unity of invention is lacking** (See Box No. III)

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. ____



as suggested by the applicant.



as selected by this Authority, because the applicant failed to suggest a figure.



as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-29

- Remark on Protest**
- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - ☐ No protest accompanied the payment of additional search fees.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC: A61K 33/16(2006.01);A61K 33/20(2006.01);A61K 33/24(2006.01);A61K 33/34(2006.01);A61K 33/42(2006.01);A62D 3/00(2006.01);A62D 5/00(2006.01)

USPC: 424/601,604,617,660,662,673;588/299,320,401,405-409,901

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/601,604,617,660,662,673;588/299,320,401,405-409,901

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

STN: REGISTRY and HCAPLUS databases

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	OKUN et al. "Polyoxometalates on cationic silica: Highly selective and efficient O ₂ /air-based oxidation of 2-chloroethyl ethyl sulfide at ambient temperature", Journal of Molecular Catalysis A: Chemical, 2003, vol. 197, pages 283-290, available online 10 January 2003 (10.01.2003), see especially abstract; section 2.1 on page 284; and Table 1 on page 286.	1-10, 14-19, 24 and 27
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Y	WO 99/53131 A1 (EMORY UNIVERSITY) 21 October 1999 (21.10.1999), see page 1, lines 14-19; page 4, lines 13-18; page 5, lines 1-24; page 8, line 4 - page 10, line 27; page 13, lines 17-32.	11-13, 20-23, 25-26 and 28-29
Y	US 6,420,434 B1 (BRAUE, JR. et al.) 16 July 2002 (16.07.2002), see abstract; Table 1 in column 3.	11-13
Y	WO 03/094977 A2 (EMORY UNIVERSITY) 20 November 2003 (20.11.2003), see claims 1-2, 4-12, 17-20 and 23.	20-23, 25-26 and 28-29
X, P		1-29



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

23 February 2006 (23.02.2006)

Date of mailing of the international search report

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (571) 273-3201

Authorized officer

Stanley S. Silverman

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BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions, which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-29, drawn to compositions and methods of removing a contaminant using same, wherein said compositions comprise, at the least:

a metal nitrate selected from d-block metal nitrates and f-block metal nitrates; and

a metal salt having weakly bound counter anions, wherein the metal of the metal salt having weakly bound counter anions is selected from a d-block metal and an f-block metal.

Group II, claims 30-58, drawn to compositions and methods of removing a contaminant using same, wherein said compositions comprise, at the least:

a first polyoxometalate having a first metal selected from a d-block metal and an f-block metal, wherein the first metal is an open coordinate site of the first polyoxometalate, and wherein the first metal has a nitrate terminal ligand; and

a second polyoxometalate having a second metal selected from a d-block metal and an f-block metal, wherein the second metal is an open coordinate site of the second polyoxometalate, and wherein the second metal has a halide terminal ligand.

The inventions listed as **Group I** and **Group II** do not relate to a single general inventive concept under PCT Rule 13.1, because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The special technical feature of **Group I** is the combination of a metal nitrate selected from d-block metal nitrates and f-block metal nitrates, with a metal salt having weakly bound counter anions, wherein the metal of the metal salt having weakly bound counter anions is selected from a d-block metal and an f-block metal. The special technical feature of **Group II** is the combination of a first polyoxometalate having a first metal selected from a d-block metal and an f-block metal, wherein the first metal is an open coordinate site of the first polyoxometalate, and wherein the first metal has a nitrate terminal ligand, with a second polyoxometalate having a second metal selected from a d-block metal and an f-block metal, wherein the second metal is an open coordinate site of the second polyoxometalate, and wherein the second metal has a halide terminal ligand. **Thus**, as the special technical features of the two groupings are clearly different, the claims lack unity *a priori*.

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
CHRISTOPHER B. LINDER
THOMAS, KAYDEN, HORSTEMEYER & RISLEY, LLP
100 GALLERIA PARKWAY, N.W.
SUITE 1750
ATLANTA, GA 30339-5948

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Applicant's or agent's file reference 050508-2300		Date of mailing (day/month/year)
International application No. PCT/US04/05645		International filing date (day/month/year) 25 February 2004 (25.02.2004)
International Patent Classification (IPC) or both national classification and IPC IPC: Please See Continuation Sheet USPC: 424/601,604,617,660,662,673;588/299,320,401,405-409,901		Priority date (day/month/year) 25 February 2003 (25.02.2003)
Applicant EMORY UNIVERSITY		

1. This opinion contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|--|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the opinion |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input checked="" type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input checked="" type="checkbox"/> | Box No. VIII | Certain observations on the international application |

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Date of completion of this opinion 24 February 2006 (24.02.2006)	Authorized officer Stanley S. Silverman Telephone No. (571) 272-1700
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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

- ☐ a sequence listing
- ☐ table(s) related to the sequence listing

b. format of material

- ☐ on paper
- ☐ in electronic form

c. time of filing/furnishing

- ☐ contained in the international application as filed.
- ☐ filed together with the international application in electronic form.
- ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

**WRITTEN OPINION OF THE
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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:
- ☐ paid additional fees
 - ☐ paid additional fees under protest and, where applicable, the protest fee
 - ☐ paid additional fees under protest but the applicable protest fee was not paid
 - ☒ not paid additional fees
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:
See the lack of unity section of the International Search Report (Form PCT/ISA/210)

4. Consequently, this opinion has been established in respect of the following parts of the international application:
- ☐ all parts.
 - ☒ the parts relating to claims Nos. 1-29

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Box No. V Reasoned statement under Rule 43 bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims <u>11-13,20-23,25,26,28 and 29</u>	YES
	Claims <u>1-10,14-19,24 and 27</u>	NO
Inventive step (IS)	Claims <u>NONE</u>	YES
	Claims <u>11-13,20-23,25,26,28 and 29</u>	NO
Industrial applicability (IA)	Claims <u>1-29</u>	YES
	Claims <u>NONE</u>	NO

2. Citations and explanations:

Claims 1-10, 14-19, 24 and 27 lack novelty under PCT Article 33(2) as being anticipated by the *Journal of Molecular Catalysis A: Chemical* article by OKUN et al. (hereinafter "the Okun article"). The Okun article teaches binary cupric nitrate and triflate (trifluoromethanesulfonate) systems that catalyze the homogeneous air oxidation of the mustard (HD) simulant 2-chloroethyl ethyl sulfide (CEES) (see abstract), thereby teaching compositions comprising copper (II) nitrate and copper (II) trifluoromethanesulfonate, per instant claims 1-5, and methods of removing contaminants using same, per instant claim 24. The systems of the Okun article further comprise polyoxometalates (POMs), per instant claim 6, to enhance activity (see abstract), thus compositions comprising copper (II) nitrate, copper (II) trifluoromethanesulfonate and POMs, per instant claims 15-17, and methods of removing contaminants using same, per instant claim 27, are also taught. Specific POMs include materials of structural formulae within the scope of instant claims 7-10, 14 and 18 (see the POMs disclosed at beginning of section 2.1 on p. 284; TBA salts in Table I at p. 286), thus compositions falling within the scope of instant claims 7-10, 14 and 18-19 are also taught. In summary, the Okun article anticipates instant claims 1-10, 14-19, 24 and 27, since compositions and methods meeting all required limitations thereof are clearly taught.

Claims 11-13 lack an inventive step under PCT Article 33(3) as being obvious over the Okun article in view of WO 99/53131 (EMORY UNIVERSITY, hereinafter "Emory I"). The Okun article is relied upon as set forth above, anticipating instant claim 6. However, while POMs of structural formulae within the scope of instant claims 7-10, 14 and 18 are taught, POMs of structural formulae within the scope of instant claims 11-13 are not.

Emory I teaches that POMs of structural formulae within the scope of instant claims 7-10, 14 and 18, as well as instant claims 11-13, are effective in removing contaminants, including sulfur-containing toxic gases (see p. 1, lines 14-19; p. 4, lines 13-18; p. 5, lines 1-24; p. 8, line 4 - p. 10, line 27; p. 13, lines 17-32). Accordingly, it would have been obvious to one of ordinary skill in the art, at the time of the instant invention, to supplemented and/or at least partially substituted therefor the POMs in the systems/compositions of the Okun article--disclosed as effective in the removal of mustard (HD) (i.e., a sulfur-containing toxic gas)--with the POMs of Emory I, because, as just discussed, Emory I teaches that all such POMs are effective in the removal of sulfur-containing toxic gases.

Claims 20-23, 25-26 and 28-29 lack an inventive step under PCT Article 33(3) as being obvious over the Okun article in view of BRAUE, JR. et al. (hereinafter "Braue"). The Okun article is relied upon as set forth above, anticipating instant composition claims 1 and 6 and corresponding method claims 24 and 27. However, the Okun article fails to teach including the disclosed systems/compositions in a material, per instant claims 20, 21, 25 and 28, thereby failing to teach any of the specific materials of instant claims 22, 23, 26 and 29.

Braue teaches active topical skin protectants using POMs, specifically topical skin protectant formulations containing a barrier cream and an active moiety for protecting against chemical warfare agents (CWA's), the active moiety being the POMs (see abstract; Table I in col. 3). Accordingly, it would have been obvious to one of ordinary skill in the art, at the time of the instant invention, to have manufactured the systems/compositions of the Okun article as topical skin protectant formulations containing a barrier cream (i.e., "a topical carrier", one of the materials specifically recited in instant claims 22, 23, 26 and 29), because, as just discussed, Braue teaches that such formulations are an effective means for providing protection against CWA's--the same purpose as the systems/compositions of the Okun article (mustard (HD) being a CWA).

Claims 1-29 meet the criteria set out in PCT Article 33(4) and thus have industrial applicability, because the subject matter claimed can be made or used in industry.

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the questions whether the claims are fully supported by the description, are made:

Claims 9-12 and 18-19 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6, because the claims are considered indefinite for the following reasons: 1) In each of claims 9-12, "a" is defined but not present in the recited formula; evidently, "a" should be replaced with "u". 2) In claim 9, "g", "j" and "i" are not defined; perhaps claim 9 should depend upon claim 8? 3) In claim 10, "g", "h" and "i" are not defined; perhaps claim 10 should depend upon claim 8? 4) In claim 12, "r", "s" and "y" are not defined; perhaps claim 12 should depend upon claim 11? 5) In claim 13, "r", "t" and "y" are not defined; perhaps claim 13 should depend upon claim 11? 6) In claim 18 (upon which claim 19 depends), "TBA₆Fe₃PW₉O₃₇" is recited twice.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of IPC:

A61K 33/16(2006.01);A61K 33/20(2006.01);A61K 33/24(2006.01);A61K 33/34(2006.01);A61K 33/42(2006.01);A62D 3/00(2006.01);A62D 5/00(2006.01)